NAC Aftermarket Brake Components Project (Secondary Items)

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SUPERIOR TECHNOLOGY

FOR A

SUPERIOR ARMY

RDECOM

ZACOM

The Soldier and Ground Systems Life Cycle Management Command

TARDEC

U.S. ARMY TANK AUTOMOTIVE RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

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NAC Aftermarket Brake Components Project

By: Leo Miller, USA National Automotive Center, and
Carlos Agudelo, LINK Testing Laboratories, Inc.

"Full-and-Open Competition"

- Eliminate major brake component spare parts issues resulting from "sole source" and establish alternatives to traditional on-vehicle brake system component testing without conflicting with FMVSS to qualify alternate sources of supply.

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WHY ?

- Because we (US Army) “can”!

- Because we (DOD) have to “by law”!

- Because there’s nothing out there already which is readily useable.

- Because an industry-wide off-vehicle “fix” wasn’t in the foreseeable future.

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FMVSS says:

"No manufacturer, distributor, dealer or motor vehicle repair business shall knowingly render inoperative, in whole or part, any device or element of design installed on or in a motor vehicle or item of motor vehicle equipment in compliance with an applicable FMVSS…"

(Federal Safety Act of 1966 (PL 95-599), Section 108, Paragraph 2[A])

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"While on routine patrol……"

- Project initiated as a result of Congressional interest and supplier complaints (both from PA) of inability to qualify or bid on HMMWV-ECV model "sole-source" disk brake pads.

- Basically no US Federal requirements for aftermarket parts.

- No formal military processes to "qualify" alternatives and prohibitive costs to conduct on-vehicle vehicle testing.

- Army's historical lack of in-house expertise.

- Fiscal constraints and political/managerial issues not unique to US Army, but major performance and logistical issues are.

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Program Objectives by Army Stakeholders and Other Customers.

- "Fix the problem"; "get it done as quickly as possible"; and "don't expand the scope!" !

- Develop formalized methodology/processes to "fix" the sole-source problems on latest HMMWV disk brake pads – later expanded to all vehicle systems, "if practical and value-added!"

- Keep acceptability decision with assigned vehicle system engineer or designated equivalents only!

- Make sure both the Congressman and his constituent are happy, if possible!

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Unofficial Program Objectives from PMO/ESA Stakeholders.

- **"Jennerstown testing"** Meant that realistic TOP 2-2-608 inertia brake dynometer simulations approximating vehicle tests.

- **"SAE approval"** Meant to require participation and technical input by SDO's and commercial truck marketplaces.

- **"Aberdeen approval"** Meant to require participation and technical input by military technical managers and testers, but "approval" not officially required of these orgs on secondary items.

- **"HMMWV brake temps"** Meant we must approximate highest Aberdeen Product Verification Testing (PVT) temps.

- **"Affordability"** Meant "affordability" for potential offerors without increasing risks to military users, programs, or budgets.

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Enabling Technical Decisions.

- Vehicle system engineer (aka “ESA” in specs) retains full approval authority; keep acquisition, testers, and logisticians from making decisions for Army.

- To be useable, the ATPD/MIL-SPEC can’t be “pass-or-fail” document and must be “apples-to-apples” comparison between originally OEM and alternate offerings.

-“Mandatory” shall be minimum tests, testing and observations acceptable for a reasoned decision to accept or reject.

- GVW and similar won’t work for military due to all the different models and missions, so OEM “brake rating” and OEM hub hardware for fixturing used as much as possible.

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How'd We Do it: What's an ESA ? (Short version!)

- The inclusive term "ESA" (Engineering Support Activity) shall be defined as the responsible Army vehicle system engineering authority, equivalent non-Army Governmental vehicle design authority, or non-US Governmental civilian engineering activity's designated vehicle or brake program engineer when used solely as a commercial/civilian undertaking. This definition may also include civilian commercial fleet owners or their designated surrogates when subject specification is used as a decision support tool for the specific brake replacement items covered by subject specification.

- DOD procurement offices/activities, other Government and quasi-Government procurement offices/activities, civilian/commercial buying offices/activities, and other similar non-engineering functions are specifically excluded from this definition as they do not have the vehicle system engineering expertise and/or legal approval authority required for brake systems and their subcomponents.

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Enabling Decisions (continued).

- Offeror shall pay for “mandatory” testing; “optional” testing directed by and paid for by the Government!
- Testing activity shall be ISO 17025 registered or certified prior to start of testing!
- Offerors or suppliers can not qualify their products as a result of the ATPD/MIL-SPEC validation testing by the Government!
- Maximum use of existing civilian industry standards and procedures to increase acceptance and reduce program risk!
- Initial testing structure was based on ISO CD 15484 by LINK!

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Challenges (New and Older Problems).

- HMMWV is our traditional “600-pound Gorilla”; all up-armored vehicles must be addressed.

- Common test processes must cover air and hydraulic across a broad spectrum, all presumed to be over 10K GCV.

- “Wet” brakes, odd or very low-density, and “E” brakes dropped or moved for now to reduce volume and complexity of ATPD-2354.

- The logistical and acquisition roles must be considered and common ground found between TACOM-Warren and DLA-Columbus NICPs (spares acquisitions).

- Who really has the power to say “yes” within the Government?

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Some good, some bad, and……

1. GOOD:

   a. Availability of historical Government brake test data (“Aberdeen”).

   b. CRADA partners Link Testing Laboratories & TMC/ATA

   c. Support and funding has been based on significant cost savings, not the latest silver-bullet-fix technical fixes.

2. BAD:

   a. “Rice bowl” issues both inside and outside the Government.

   b. Lack of readily available SDO and/or commercial equivalent specs for off-vehicle/non-FMVSS performance, wear, crack/fatigue, etc.

   c. Nothing already in-place to fix/modify and most active vehicle stakeholders perceived as risk-adverse/reluctant to be first to adopt.

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Create, Innovate, and Exploit to Achieve Goals!

1. Four Test Methods give “apples-to-apples” data to cover legacy vehicles, over-loads, commercial/non-tactical, and pure R&D.

2. Fixturing is defined and limited by Test Method to reduce complexity, costs, and duplications; alternatives provided.

3. TARDEC-managed “ATPD” allows early implementation by TACOM and DLA to fill time gap before DODISS approvals.

4. Proposed test methodology must be practical and sellable to all potential users: PEO/PMO, TACOM, DLA, other Services, etc.

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What's it look like?

ITEM	ATPD 2354 (MIL-SPEC) Mandatory Test Plan TYPE OF TEST Test Plan No. 1: Disc pads and brake shoes	Hydraulic Air/Both	Standard/Test procedure	TEST PLAN	
				Baseline & One (1)	# of test
	PHYSICAL & DIMENSIONAL PROPERTIES				
1	Material Identification/Certifications - as required when identified by requirement, specification, drawing, or purchase order.	both	CoC/Lab Results	All & All	12
2	Visual inspection	both	ISO/PAS CD 22574 (FEMFM website)	12 & 12	24
3	Pre-test inspection and measurements	both	MIL-STD 810 paragraph 4.4.1.1	12 & 12	24
4	Shear strength adhesion/bonding (-40 °C)	hydraulic	SAE J840 (ISO 6312)	3 & 3	6
5	Shear strength adhesion/bonding (750 °F) (400 °C)	hydraulic	SAE J840 (ISO 6312)	3 & 3	6
6	Compressibility, ambient	both	SAE J2468 (ISO 6310)	3 & 3	6
7	Compressibility, elevated temperature	both	SAE J2468 (ISO 6310)	3 & 3	6
8	Hardness on metallic parts (rotor, drum, shoe, backing plate)	both	ASTM E 10	3 & 3	6
9	Thermal swell and growth	both	SAE J160	3 & 3	6
	INERTIA-DYNAMOMETER FRICTION BEHAVIOR and PERFORMANCE				
10	Friction Behavior and Performance Assessment Hydraulic Brakes single-ended; with front/rear balance assessment (up to V_{max})	hydraulic	SAE J2522 (ISO NWI 26867) (SAE J2784)	3 & 3	6
11	Hill hold ability evaluation (included in item 10)	hydraulic	ATPD 2354 paragraph 5.6		
12	Friction Behavior and Performance Assessment Air Brakes single-ended; with front/rear balance assessment	air	SAE J2115	3 & 3	6
13	Hill hold ability evaluation (included in item 12)	air	ATPD 2354 paragraph 5.6		
14	Friction Behavior and Performance Assessment Hydraulic Brakes dual-ended left/right (up to V_{max})	hydraulic	SAE J2522 (ISO NWI 26867) (SAE J2784)	Mixed	3
15	Friction Behavior and Performance Assessment Air Brakes dual-ended left/right	air	SAE J2115	Mixed	3
	INERTIA-DYNAMOMETER PERFORMANCE, WEAR, and NOISE (TOP 2-2-608)				
16	Jennerstown Fade Dyno test with noise	both	ATPD App. XX W05065LINKA-C1	3 & 3	6
17	Wear and durability (Laurel Mountain 4 Cross-Country cycles) with noise	both	ATPD App. XX W05065LINKA-C1	3 & 3	6
	Total number of test samples submitted by axle sets			**20 & 20**	

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What's it look like?

ITEM	ATPD 2354 (MIL-SPEC) Mandatory Test Plan TYPE OF TEST Brake rotors and drums	Hydraulic Air/Both	Standard/ Test procedure	TEST PLAN	
				Baseline & Candidate	# of tests
	PHYSICAL & DIMENSIONAL PROPERTIES				
1	Material Identification/Certifications - as required when identified by requirement, specification, drawing, or purchase order.	both	CoC/Lab Results	All & All	12
3	Pre-test inspection and measurements	both	MIL-STD 810 paragraph 4.4.1.1 & W05036LINKB-DO "REV X"	All & All	12
4	Hardness	both	ASTM E 10	3 & 3	6
	INERTIA-DYNAMOMETER ROTOR/DRUM PHYSICAL PERFORMANCE				
6	Disc and Drum crack and strength test	both	W05036LINKB-DO "REV X" (SAE J2686 drum)	1 & 3	4
	INERTIA-DYNAMOMETER FRICTION COUPLE PERFORMANCE AND DURABILITY				
7	Friction Behavior and Performance Assessment Hydraulic Brakes single-ended; with front/rear balance assessment (up to V_{max})	hydraulic	SAE J2522 (ISO NWI 26867) (SAE J2784)	3 & 3	6
8	Hill hold ability evaluation (included in item 7)	hydraulic	ATPD 2354 paragraph 5.6		
9	Friction Behavior and Performance Assessment Air Brakes single-ended; with front/rear balance assessment	air	SAE J2115	3 & 3	6
10	Hill hold ability evaluation (included in item 9)	air	ATPD 2354 paragraph 5.6		
11	Jennerstown Fade Dyno test with noise	both	W05065LINKA-C1 "REV X"	3 & 3	6
12	Wear and durability (Laurel Mountain 4 Cross-Country cycles) with noise	both	W05065LINKA-C1 "REV X"	3 & 3	6
	Total number of test samples submitted by axle sets			**20 & 20**	

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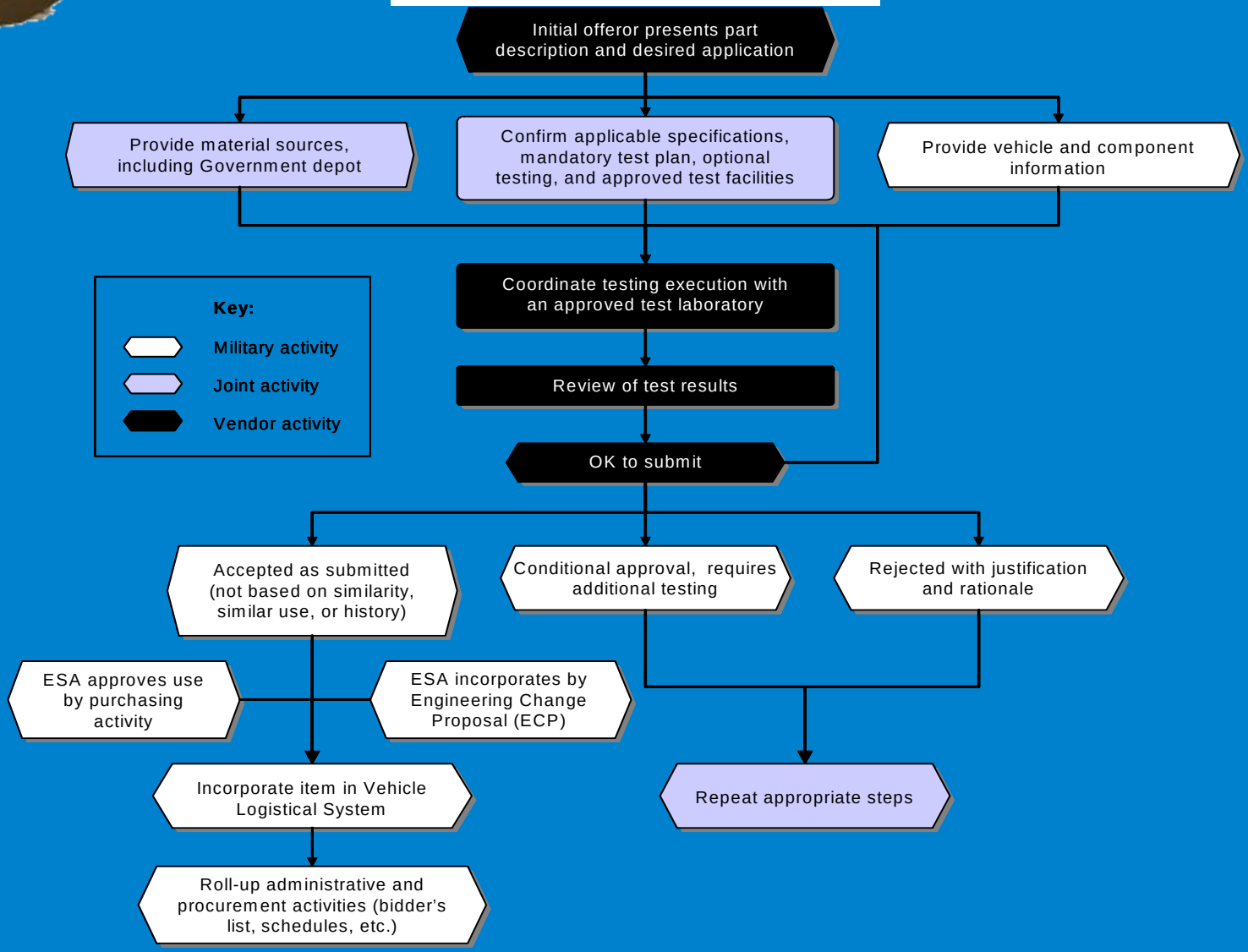
What's it look like?



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What's next?

1. Co-author SAE and TMC/ATA Draft Recommended Practices (RP) by LINK and TARDEC under existing agreements, 1CFY07.

2. Convert interim "ATPD" to MIL-STD-962 style Federal Test Standard during 2-3QCY07.

3. Potential follow-on development of ISO/ECE and/or Federal requirements effort with commercial industry partners.

4. High-potential proposal by DLA-Columbus (DSCC) to expand project to cover "all" ground vehicle brake system spare parts.

Summary and Points of Contact.

"We took what was there, added some ISO, MIL-SPEC, and LINK stuff (with their permission) and created a workable and sellable output that will benefit the US Army and, by extension with appropriate changes, will form the basis for similar programs in the civilian sector." (Leo, Jul '06)

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